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The Improvement of Burn-out Lands in Southern Saskatchewan

Interim Report on Investigations now proceeding

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TABLE OF CONTENTS

3539—1½

THE IMPROVEMENT OF BURN-OUT LANDS IN SOUTHERN SASKATCHEWAN

It has been estimated that in Southern Saskatchewan alone there are more than 650,000 acres of so called burn-out land. One of the largest areas of this land, and the one with which this pamphlet deals particularly, lies west of Weyburn. It extends as far west as Khedive on the Weyburn-Assiniboia line and from Truax to a short distance southeast of Radville on the Avonlea-Radville line.

NATURE OF THE SOIL

In appearance the burn-out lands are characterized by roughly circular depressions varying in depth from about 4 to 6 inches, and in width from a few feet to as much as thirty feet. The important difference between the burn-out spots and the surrounding soil is that the burn-out spots have apparently lost a considerable portion of the original surface soil, leaving exposed a grey-coloured, hard, impervious, and somewhat unproductive zone. The normal soil adjacent to the burn-out spots is brown in colour and may be described as a fine sandy loam or a clay loam of reasonably high productivity. According to analysis, the normal soil contains considerably more nitrogen and organic matter than the burn-out spots.

EXPERIENCE OF SETTLERS

The early settlers soon realized the problem they had in breaking up this land to a sufficient depth and working it so as to improve the productivity of the burn-out spots. They used home-made scrubbers or floats for levelling the surface after breaking and in this way moved a portion of the top loam soil from adjacent areas into the depressions. This was found to give good results though adding to the cost of preparing the land for a crop. It was also soon discovered that it required considerable power to pull ploughs and other tillage implements through these hard spots. For these reasons and also due to lack of capital, and in some cases distance from market, many of these early settlers became discouraged and gave up their homesteads. Some stayed with it and in recent years other settlers have taken up some of these vacant lands and are putting them under cultivation, in a good many cases with the aid of tractors. The advent of the medium sized tractor together with improvements in tillage implements have been two factors which have helped considerably in bringing this land into a good state of cultivation. More initial capital is required to do the breaking with a tractor, yet if one can do it in this way, usually a better job can be accomplished and more progress made.

Those settlers who have persisted have shown that profitable crops can be produced on these lands even though the cost of production for the first few years has been greater than on the normal types of soil.

ILLUSTRATION STATION WORK

In 1916 an Illustration Station was established one-half mile east of the town of Radville. This land had been under cultivation for a few years and the burn-out spots were partially levelled. The use of the scrubber was continued after each ploughing to fill in the depressions more fully. Both grain and forage crops were grown, such as wheat, oats, barley, corn, western rye grass, brome and sweet clover. One system followed was to grow two crops of wheat before summer-fallowing the land, which is the usual practice of most farmers in the district. Wheat was also grown on summer-fallow after two crops of hay. Oats and barley were grown after wheat. The results showed that all these crops could be grown, and in seasons of favourable moisture good yields were obtained, particularly with the grain crops.

Owing to a change in the tenancy of this land in 1923, the location of the station was changed to land three miles north of Radville. This land was right in the burn-out area and had been under cultivation for a number of years. Similar work was continued here. Three rotations of crops were started as follows: (1) the three-year system of two crops of wheat and fallow; (2) a two-year system of wheat and sweet clover hay; (3) a six-year system of wheat, oats, corn, wheat, hay, fallow.

The results from six years' work on this station have shown what can be expected from growing crops under these different systems. The chief purpose of growing these crops in rotation has been to get information not only on the yields, but also their effect on the land and on the crops following. Western rye grass, sweet clover, alfalfa and corn had not been grown to any extent in this district before, so it was considered advisable to give these a fair trial as well as the ordinary grain crops. So far results have indicated that such crops as sweet clover and grass tend to improve the tilth of this soil. In this respect sweet clover has been more effective than the grasses. Corn has not proven a very suitable crop for the burn-out land and yields of wheat following corn have been very little more than the yield of wheat on stubble land. Wheat on all summer-fallowed land has given favourable yields on the average but on stubble land (spring ploughed) the yields have been just about one-half as much.

Illustration work was started in the Trossachs district on typical burn-out land in 1923 on the farm of Mr. Charles Carlson six miles south of town. The same general plan of work has been carried on here as at Radville Station. The results obtained have been quite similar to those at Radville. The difference between the yield of wheat on fallow and stubble land has been even greater here than at Radville.

EXPERIMENTAL WORK

With increasing areas being brought under cultivation there arose a very general demand for more information on the problems of breaking and cultivating burn-out lands. In response to this demand Illustration Station work was expanded in the year 1926 by acquiring the use of an unbroken quarter section on which to carry on both Illustration and experimental work.

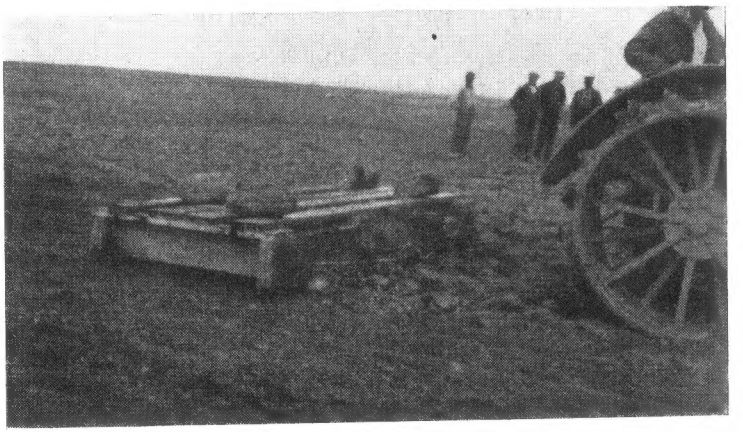
Experiments on time and depth of breaking, the value of backsetting, floating, subsoiling, manuring, liming and other treatments designed to improve the tilth of the soil, were undertaken. Different crops including wheat, oats, barley, flax, rye and sweet clover were sown to learn which would be best adapted to the soil and in case of sweet clover to learn what effect it might have in improving the soil for other crops. In 1929 the work was further increased by the inclusion of a comprehensive fertilizer trial and other work designed to more clearly indicate the exact nature of the deficiency of the soil.

RECOMMENDED PRACTICES FOR BURN-OUT LANDS

Breaking

From data so far obtained, as well as from a study of the experience of farmers in the district, it is fairly apparent that in breaking the virgin land, the work should be done early in the season to a depth of not less than four inches and preferably deeper. After breaking, the land should be thoroughly disked and then floated with a float of sufficient weight and length to drag the maximum amount of top soil into the burn-out areas. Both disking and floating should be repeated, if possible, later in the season. In the spring the land should be again disked prior to seeding in order to loosen the soil in the burn-out spots and permit ready penetration of the drill.

Shallow breaking early in the season, and backsetting to a greater depth later, have given very good results on this land. But the great difficulty of ploughing to any considerable depth late in the season, together with the added cost of this method, make the deep breaking, disking and floating the more economic procedure. Before attempting to break the burn-out land, it is necessary to remove the larger stones. Ploughshares and disks should be kept sharp at all times.



Levelling and filling in the burn-out areas with a planker.

Second Year after Breaking

If the land has been well broken, disked and floated, it may be advisable to take a second crop from the new land before it is summer-fallowed. If a second crop is taken, the land should be fall or spring ploughed and thoroughly disked before seeding. If the original breaking, disking and floating were not well done, it might be advisable to summer-fallow before a second crop is seeded.

Summer-fallow

Results so far obtained on the station strongly indicate the advisability of frequent and thorough summer-fallowing. At both the Radville and Trossachs stations wheat on fallow had produced double the yield of wheat on ploughed stubble land. These results bring up the question as to how frequently the land should be fallowed. Strict application of the figures would indicate that half the land should be fallowed rather than one-third. However, it would be unsafe at the

present time to recommend the general adoption of the alternate crop and fallow method. All that can be said is that the matter should receive the careful consideration of every farmer and that in all cases, at least one-third of the land should be in fallow. In working the summer-fallow the same general principles should be observed as in breaking and preparing new land for crop. In addition care should be used to keep weeds under control.

Early disking followed by deep ploughing when the soil is in the most suitable condition are important steps in the summer-fallow work. If the land is ploughed when too wet, baking of the furrow slice is likely to occur, thus greatly increasing the work required to bring such land into good tilth later. If the land becomes too dry before ploughing is attempted then poor work results from the fact that the plough cannot be kept at a proper depth in the soil. Weeds will not be killed, burn-out spots will not be loosened and the draft of the plough will be increased.

After ploughing, disking and floating, the stiff-shanked cultivator may be used to good advantage to control weeds and to keep the surface in condition to absorb rainfall readily.

Prior to seeding in the spring, the use of the disk or cultivator is necessary to loosen the hard spots and permit of seeding to a proper depth.

Preparation for Second Crop

In some parts of the prairies, disking stubble land for a second crop is equal, or superior, to ploughing. This is distinctly not true on the burn-outs. If time and moisture conditions permit, fall ploughing with thorough disking in the spring, is a good practice. In most years however, only a limited amount of fall ploughing can be done. Spring ploughing followed by disking will then be the best method of preparation for spring sown grain crops.

Implements and Tillage Methods

In the sections of this pamphlet dealing with the preparation of land for seeding, deep ploughing and thorough work generally are indicated as being desirable. To accomplish such work two things are essential: first, ample power, and second, well-adapted implements in good condition.

For breaking and heavy work, tractor power is usually more satisfactory than horse-power, even though in wet periods difficulty may be experienced in preventing tractors from becoming mired. Wheel tractors should be equipped with extension rims and six-inch spade lugs. Some method of preventing the accumulation of mud between drive wheel lugs, is frequently a necessity. A very satisfactory device for this purpose may be made as follows:—

From old waggon tires make a ring about two inches greater in diameter than the tractor wheel. Remove the outside row of lugs, slip the ring on to the wheel and replace the lugs. The ring will be loose on the wheel, but not so loose as to come off over the lugs. Another device which has proven fairly satisfactory consists of scrapers fitted to a pipe which in turn is carried on the fender brackets. The pipe is carried in eye bolts so that by means of a convenient handle the scrapers may be thrown against the wheel as necessary.

The most important tillage implements for burn-out lands are the mouldboard plough, the disk harrow and the home-made float or scrubber. The disk plough can often be used to good advantage, but its use is not essential, provided the mouldboards can be made to scour. If difficulties are experienced in getting mouldboards to scour, draft adjustments, different shaped mouldboards and even wider plough bottoms might be tried before abandoning the mouldboard plough in favour of the disk plough.

A special deep tillage implement called the " Killifer Chisel " has been tried at Radville for one year only, on both summer-fallow and stubble land. It has been used as a subsoiler to stir the soil to a depth of four to eight inches below the ploughing. Although it requires considerable power to pull this implement, especially at the greater depths, results so far have shown that the hard soil has been loosened and yields of grain crops increased to some extent. It has not been tested for a sufficient time to justify a definite recommendation, as yet. However, it has given promising results so far and further trials will be made to obtain more information on its efficiency under different conditions.

Deep ploughing with a tractor in the depth-of-ploughing experiments at Radville.

A good homemade float or scrubber is almost indispensable on a farm on which much burn-out land is cultivated. No other device has been found so effective in filling depressions and generally improving conditions of the soil. A useful float can be made with 3 by 12 inch planks 12 or 14 feet in length as the main parts. These should be spaced about four feet apart by means of lengths of 2 by 8 inch planks and the whole held in shape by $\frac{5}{8}$-inch iron rods and 4 by 4 inch diagonal bracing. The cutting face of each of the 3-inch planks should be protected from wear by a flat iron bar $\frac{3}{8}$ inch thick, 2 inches wide and of a length equal to that of the planks.

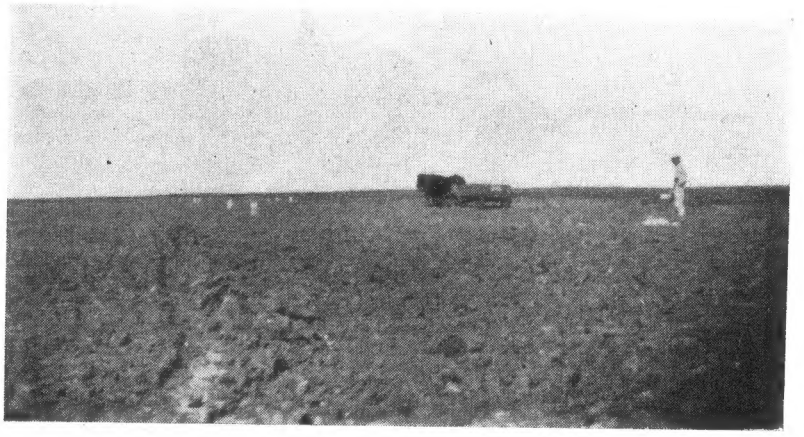
After land has been under cultivatioin for some years, the stiff-shanked cultivator will be found a very useful implement for summer-fallow work. In many cases the cultivator equipped with two or four-inch shovels is more effective in loosening hard spots on the summer-fallow just prior to seeding than is the disk. If a choice must be made between cultivator and disk the latter will have a wider range of uses.

Packers would seem to be entirely out of place on burn-out land for the reason that, ordinarily, much effort must be devoted to loosening the soil. However, it has been observed that when the soil has become baked into heavy clods, perhaps as a result of ploughing when too wet, a packer, particularly of the culti-packer type, may somewhat improve conditions by pulverizing the clods.

Manures and Fertilizers

While farmyard manure has been tried on the burn-out lands for many years, it is only in recent years that any experiments in the application of lime and commercial fertilizers have been carried out. Contrary to expectations, the application of moderate amounts of lime has not resulted in any marked improvement in the soil tilth nor in crop yields. Possibly the amounts used have been too small to have the mellowing effect usually expected from the application of lime to stiff clay soils.

Commercial fertilizers have been tried for one year only. The fertilizers were all broadcast on the surface and disked into the soil. Practically no difference could be observed between the fertilized and unfertilized plots. However, it would be unsafe to conclude from a single year's results of broadcast application that fertilizers will never benefit crops. Henceforth the fertilizer will be drilled into the soil with the seed and the tests of both lime and fertilizers will be continued until definite conclusions can be reached.



Applying lime in the burn-out experiments.

Applications of 15 tons of rotted manure per acre have given variable results, but on the whole, yields and uniformity of stand of crop have been somewhat improved by this practice. In dry years some tendency toward burning of the crop has been observed. The greatest benefit has been derived from manure in the wet years.

If a labour charge must be made for applying the manure then the extra returns have not been equal to the cost of application. If, as is usually the case, manure must be hauled away from the buildings in any event, then the extra cost of spreading it on the land is so small as to warrant this procedure. The most suitable place to apply manure is to the burn-out spots on land which is to be fallowed; thus giving an opportunity to have it thoroughly incorporated with the soil before a crop is grown.

It should be realized that even though manure is useful on the burn-outs there is little hope of making any extensive improvement by this means because of the very limited amount of manure available on most farms.

Crops and Rotations

Since Illustration work was started on the burn-out lands the following crops have been grown: wheat, oats, barley, fall rye, flax, peas, corn, sweet clover, rye grass, brome grass and alfalfa. Concerning each crop two matters of chief importance have been under observation; namely, the value and adaptation of the crop itself and its effect on other crops which might be grown in later years on the same land. While the extent of the work does not permit of anything like final conclusions with respect to all crops, such conclusions as may be drawn are indicated in the following paragraphs.

WHEAT

Wheat has been grown as the chief cash crop in this district on both fallow and stubble land. Results have shown that this crop is well adapted to the district, especially when sown on fallow land. Yields as high as 37 bushels per acre have been obtained on the station fields. The average yield for a period of six years at the Radville station on fallow land has been 24 bushels per acre and on spring ploughed stubble land 12 bushels. At Trossachs for the past five years the average is 19·6 bushels on fallow and 8·2 bushels on stubble land. There has been a marked difference in the yield on fallow as compared with that on stubble land. On the basis of these yields it would seem that the system of growing only one crop of wheat after the summer-fallow is more profitable than growing two crops as is the general practice followed in the district at present. However, it may be too soon to draw definite conclusions on this point, but the two-year system of grain and fallow is worthy of further trial and may prove the most profitable, particularly during the early years of settlement on this land, until it reaches a good state of cultivation.

On the burn-out soils, to obtain the best quality of wheat it is necessary to allow the grain to become well ripened before harvesting. On the hard spots the grain usually keeps green longer than on the rest of the field and unless extra time is allowed for this many green kernels will be present in the threshed grain which will lower the grade.

The chief variety grown in this district at present is Marquis. On the station fields at Radville and Trossachs it is also the chief variety and, on the whole, so far has given the best results. Other varieties such as Kubanka, Early Red Fife, Garnet and Reward have been tried. In a year of rust damage Kubanka gave a much heavier yield than either Marquis or Early Red Fife, but otherwise it had no advantage. Garnet did not give as good results as Marquis in two years' trials. Reward was grown last year and gave good results for a dry season. It will be further tested to ascertain its suitability for conditions in this district.

While such matters as rate, time, and depth of seeding have not been specially studied on burn-out land, the common experience is that fairly early seeding at a rate of 75 pounds per acre to a depth of two or three inches is most generally satisfactory.

As already pointed out in the discussion of summer-fallow and tillage methods, the tilth of the soil has a very important bearing on the success of all grain crops.

OATS

Oats (Banner and Victory) have been grown on the station fields principally as a feed crop. This crop has been grown after wheat as a rule except one year when it was grown on breaking at Radville.

For the past six years the average yield at Radville following wheat has been 27½ bushels per acre with the highest yield 47 bushels. In comparison with wheat as a cash crop, where both are grown on stubble land, they have given about equal returns over a six-year period. At Trossachs the highest yield has been 60 bushels but the average yield at this station has been lower than at Radville.

BARLEY

Barley occupies a comparatively small place on the burn-out lands at present. It has been sufficiently grown however to indicate that it produces about the same relative yield, compared with oats and wheat, as in other districts. There is not any reason why barley cannot be grown regularly if market and other conditions warrant.

FALL RYE

Fall rye has been grown to a limited extent and with fair success on the station at Radville. It does not seem, however, that there is any particular place for fall rye in the agriculture of the district generally. If weeds increase materially, rye may be used as a part of a general control plan.

FLAX

Flax has received very little study on the stations and has been tried to only a limited extent by farmers and usually on newly-broken land. The general impression is that flax is not as well adapted to the burn-out conditions as wheat. In any event the returns from wheat are generally higher and this is the deciding factor with respect to the crop to be grown.

SWEET CLOVER

For some years sweet clover has been grown fairly extensively both in the district and on the stations. On the stations it has, on the whole, produced higher yields than any other hay crop. At Radville the average yield for six years has been 1½ tons per acre and at Trossachs approximately the same. It has

Sweet clover on burn-out lands.

never failed to make a stand at Radville and has given as much as 3 tons with two cuttings in a favourable season. At Trossachs it failed only one year and oats were then substituted. The clover hay has been fed to livestock with good results, especially at Radville where Mr. Stockton, the operator of the station, maintains a herd of dairy cows.

Sweet clover has also proven a good crop for improving the burn-out soils. The roots penetrate deeply and tend to loosen the hard soil so that more moisture and air can be absorbed and the productivity of the burn-out spots increased. There has been some difficulty in securing a good catch in some of the burn-out spots, particularly if they have not been worked well before seeding. After these hard spots have been under cultivation longer and more sweet clover grown, the conditions improve.

Wheat has been grown directly after sweet clover and also after sweet clover with a year of regular summer-fallow intervening. The yields of wheat directly after sweet clover have been, on the average, about equal to the yield of wheat on spring-ploughed stubble land. Where a fallow intervened before seeding the wheat, the yields were much heavier and the growth of the crop more vigorous. These yields were also heavier than wheat on ordinary fallow land where sweet clover had not been grown.

Emphasis must be given to the fact that when good yields of sweet clover have been secured, yields of wheat on the same land in the following year usually have not been good. Experience has shown that in order to derive any considerable benefit to grain crops from the growth of sweet clover it has been necessary to restore the moisture supply by means of a summer-fallow before seeding to wheat.

When wheat is grown directly following a crop of sweet clover, the land is usually prepared by ploughing soon after the hay is taken off and giving some cultivation then and also more the next spring. Should land be too dry to make a satisfactory job of ploughing, it is left until the next spring.

This plan of cropping, while it gives some crop every year, has not given profitable returns over a period of four years in this district. In regions of heavier rainfall it has given satisfactory results and also in one very wet season on the Radville Station.

Ploughing under a crop of sweet clover at about the same stage as it is cut for hay has been tried. This has not been tested sufficiently to draw definite conclusions. Wheat has been sown following this treatment. The results so far have shown that there is very little difference in yield of wheat from this treatment as compared with wheat after sweet clover when the hay is cut and taken off. The difference would not compensate for the loss of the hay crop. Further experiments will be carried on with ploughing in of sweet clover at different stages to obtain more information on this matter.

The method followed in sowing sweet clover has been to sow it with the grain crop of wheat, oats or barley at 12 to 15 pounds per acre of seed, the grain being sown at the usual rate. It has usually been sown on summer-fallowed land or after corn, but satisfactory catches have also been secured by sowing with the second crop of grain after fallow. As a rule, however, the stand is better when sown with the first crop after fallow.

In cutting the sweet clover two methods have been tried on the station fields, the mower and the binder. Both do the work satisfactorily, but in curing the binder method has the advantage, particularly if the weather is unfavourable as is often the case. The sheaves are made fairly small and stooked in small long stooks. Under usual conditions these stooks will cure without being disturbed though it usually takes considerable time, often two weeks, or sometimes even longer, depending on the weather. If stacked before being sufficiently

cured molding may take place. Before stacking, the stooks are spread out to dry. By this method of curing a better quality of hay can usually be made as more of the leaves are saved than when the curing is done in the windrow or coil.

WESTERN RYE GRASS

This crop has been grown on the Illustration Stations in the burn-out area each year since work was started. It has also been grown in a mixture with Brome grass. In quality of hay it has been quite satisfactory, but the yield has been low as compared with sweet clover. For a five-year period at Radville it has given three-quarters of a ton per acre average yield. As a soil improver it adds considerable fibre to the soil and thus improves the tilth, yet the yields of grain following the grass crop with a summer-fallow intervening have not been as high as the yield on sweet clover land similarly treated.

ALFALFA

Alfalfa has been grown on the station at Radville in a mixture with western rye grass for three years. This has made an excellent quality of hay with a fair yield. Another field of Grimm alfalfa alone was seeded last spring in order to obtain more information on the possibilities of this crop as a soil improver as well as a hay crop. Alfalfa roots go down deeply into the soil and on old established fields even more than sweet clover and should help considerably in improving the texture of the hard spots.

In using this crop for improving the soil, it has some disadvantages when compared with sweet clover. These are as follows: (1) Expensive seed; (2) Difficulty of breaking the sod; (3) It is a perennial crop and requires at least three years to reach full development which makes it less suitable for short rotations with grain.

OTHER CROPS

Corn and sunflowers have both been grown for silage, the former also for fodder. Sunflowers have given a heavier yield but the grain following this crop has not been so good as after corn. In districts such as this where stands of sweet clover can be secured, silage crops are not so essential as in some other districts. The hay crop can usually be grown more cheaply as the labour is much less and it can be handled with the ordinary machines used on every farm.

CONTINUATION OF INVESTIGATIONS

The importance and extent of the problems under investigation on these burn-out lands warrants a thorough and complete study, carried out over a period of years, to determine the response in crop yields from the different treatments under varying seasonal conditions. The results from the experiments under way have not been continued long enough to draw definite conclusions or to make specific recommendation, in view of the investigational aspect of the work having only started in 1926. This work is being continued and materially expanded in order that definite information may be available as to the most practical means of reclaiming and handling such soils. This pamphlet is, therefore, presented as a preliminary report on investigations now proceeding and must not be interpreted as a final treatise on the subject.

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